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SILESIAN BOTANICAL GARDEN – A PROPOSAL FOR AGRICULTURE AND FORESTRY

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For most people a botanical garden is a place of recreation and relaxation. Nevertheless, modern botanical gardens are also scientific and educational centres, institutions of which the most important function is the biodiversity conservation.

COUNTRYSIDE – THE NATURAL ENVIRONMENT

Considering the causes of environmental changes in the countryside we obviously realize the role of connection between the natural environment and the awareness of the inhabitants. The range of the changes is clearly visible. But, changes introduced in a wrong form or/and in a wrong time may have a negative influence on the inhabitants for many years.

A human being lives in a definite world. His existence has always been, is and always will be dependent on the environment and its modification. The human fields of activity, like science, culture, art, tradition result from the mutual influences between the mankind and the nature. If we understand this relationship, we will be able to conserve the right direction of development of the human activities in a delicate matter, which is natural environment in the countryside. Unfortunately, it is very easy to upset a balance in this matter and there is a continuous risk of introducing changes in a wrong direction. Relationships in the natural environment change in a very dynamic way. The nature changes continuously and so does a human being. These are irreversible processes. Nothing is static, nothing is accepted once and forever. Even if we conserve some certain and steady values, there are countless possibilities of changes.

A society develops, human needs change and so do the manners of solving problems and satisfying the needs. The pressure to satisfy human needs is the cause of the fact, that the way of using the goods of the nature is not always right. Thus a real threat arises of destroying the delicate balance in the environment. However, we need to remember that any activity in the line of contact between the Nature and human being must not be extreme and the sake of the both sides must be taken into account. The increasing agricultural production forces using more and more chemicals and new technological treatments that usually violate the balance in the environment. We often do not realize how soon this leads to degradation and erosion of soil, followed by irreversible reduction of its fertility. What is more, such interventions as cutting out free-growing trees, swamps and ponds drainage and removing baulks result in destroying the natural landscape.

The natural balance in the biosphere with its biological diversity is a result of millions years of evolution on Earth. Each living organism is adapted to some climatic and geological changes and, in specific degree, dependent on food chain in a given ecosystem. The consequences of violating this balance are alarming: diversity of animal and floral species decreases dramatically. All human efforts to prevent the environment from degradation seem to be

hopeless, as our intervention into the Nature often disobeys the natural law, thus eventually it inevitably leads to self-extermination through depletion of life. Such intervention is always fated to fail, because we can hardly predict the influence of chemicals on life processes in soil or cutting out trees on climate.

It is really important to balance the two quality and quantity of activities in this field. We know, that searching for some universal solution is aimless. Every single agricultural environment, every single area possesses its unique human and natural resources. Because of this unique character of each area it is difficult to work out a general scheme of preventing activities, but at the same time this diversity is a precious treasure of the natural and human potential. Much work and commitment of many people representing various social groups is necessary to skilfully fit all the elements of this puzzle of mutual connections. And much effort will be necessary to maintain the fitted harmonic pattern, never let it get destroyed and make it become more and more perfect.

Natural and social structure of agricultural regions is decisive for the ways of environment protection. Except for nature itself, also people, their tradition and culture are the natural wealth of the country, because these are just people who, literally and metaphorically, build up a local landscape. Water, forest, fields, all these create landscape, they are a natural heritage and result of the ancestors' activity. We are given this wealth just for a while. And our aim is to hand it down in better condition. Nature had existed long before any human came into life. When human had intruded, a process of using and modifying a local landscape started. The process itself is not wrong, however, the most important thing is to protect environment from damage. If we do not keep control over it, nature and people will inevitably get into a spiral of wrong interaction. And it is not a remote problem: we can observe how easily some barbarian acts become habits, for example, huge trees decapitation or burning meadows, waste land, pastures and fields.

We should realize, that in order to ensure advantages of coexistence for both sides, using our knowledge about the Nature, we have to take care of the landscape, so that it becomes a helpful element for the inhabitants in their activities and needs (Szendera 2001ab). Well organized countryside is able to take care of the local landscape. This kind of activity may result in increase in attractiveness of the country for its inhabitants, visitors and potential investors. It also enables working out programs of bringing local fields into cultivation. As a result we obtain a bigger effectiveness of the agricultural environment, especially in satisfying inhabitants' needs, with respect to the natural laws. Environment protection means some specific activities and work, so it may become a job for local inhabitants. Thus a common wealth, which is environment, can be a source of extra profit to all members of a local community.

Let us look carefully at a village. A very important element of the country is the spatial arrangement, all kinds of buildings like farmhouses, barns, industrial buildings as well as residences, small chapels or even old tombs. If well arranged and right introduced such objects form a harmonic view with the existing landscape. Unfortunately, wrong arrangement is also clearly visible. Arrangement of buildings and roads is usually a kind of a historical record for a village. Some of them have been arranged in harmony with natural landscape, others have not. For example, suitable project for a common village road may result in a spectacular and natural effect (see also Kojs and Kojs in this volume of the Bulletin). Thus a local road may be a proud of the village or an element destroying local life in many aspects because of heavy traffic, caused by lack of peripheral road. Some objects may become a real problem. For example, old buildings that have lost their former character and function, like windmills or watermills. A good solution would be transforming such objects into tourist or gastronomic points or/and into small workshops producing the so called clean energy. Anyway, a new application of old objects could be profitable for people as well as for environment. It is very important to take care of harmonic arrangement of objects and their functions with environment because it is crucial to the wealth of a given area protection. What is more, the harmony makes a social life easier and positively influences development of a village.

Another element that influences human life and behaviour is protection of places of religious worship, historical monuments and ceme-

teries. Neglecting this element may be a reason for the fact, that a village loses its character or specific spiritual climate, inhabitants become unable to conserve their identity, affection to land vanishes and inhabitants are no more interested in any events in the neighbourhood. In the situation like that some inhabitants may prevent themselves from their public activity, sometimes they even may interfere with a *pro publico bono* activity of other people. Another hardly appreciated wealth are local relics of techniques. It is necessary to take care about them as they are a testimony of our ancestors' intellect and skills. Obviously, they can enrich countryside in a material and spiritual meaning.

Needs of contemporary food market have caused changes in the hitherto agricultural fields structure, which directly influences quality and quantity of both floral and animal species composition. Loss of some traditional agricultural cultivations has resulted in negative natural consequences. Nowadays it is difficult to find hemp or linen fields in the country. Vetch and millet are hardly ever cultivated, as well as sub-species of some fruit trees. The world tendency to get natural food is a great chance to the countryside, because traditional nutritive plants can be cultivated there with neither extra costs nor intensive agro-technical methods and so with no damage to the natural environment (Brząkalik 2004).

TASKS FOR BOTANICAL GARDENS AND PROBLEMS IN AGRICULTURE AND FORESTRY

Contemporary botanical gardens play an important role in the development of many branches of agriculture. In fact, agriculture needs support from botanical gardens. Nowadays nobody may deny the so called phenological gardens or the centres of plant resource conservation their importance for development of agriculture.

Free-growing bushes, refugia and other "field gardens"

Nobody doubts that natural biotopes like water-logged terrains, stone walls, old avenues as well as free-growing trees and shrubs should be protected. Free-growing trees conserve biodiversity thus enriching agricultural areas in wild species of plants and animals. There are many advantages of planting free-growing trees, they reduce the strength of winds, keep water in the soil and protect a local area from industry pollution. Either free-growing trees or bushes growing in the meadows or along watercourses and roads enrich local agricultural landscape. A set of neighbouring groups of free-growing trees may function as the natural network of "environmentally friendly corridors" for various organisms. Free-growing trees cutting may appear dangerous for a local environment.

Weeds guarantee the life of agrocenoses

Diverse structure of the agricultural landscape may be obtained not only by free-growing trees and shrubs planting or by maintaining the retention of water, but also by crop rotations with plants keeping the biological life of soil in good condition. A big regional botanical garden might be a kind of an experimental area for introducing perennial cultivation into the system of crop rotations and for avoiding congeneric cultivation in big areas. Traditional agrocenoses vanish and many species become extinct because of changes of methods in agriculture; some the endangered species are: *Adonis vernalis*, A. *flammea* or *Hyoscyamus niger*.

Agriculture and forest service in the mountains

Mountain environment plays a basic role in the global ecosystem survival. However, most of local mountain ecosystems is undergoing degradation as a result of anthropopressure. Thus it is necessary to undertake works leading to proper managing the resources of mountain terrains. Protection of water systems, preventing erosion of soil and development of the ecotourism should be taken into consideration. Because of the excessive cutting of forest trees the surface features are changed as a consequence of soil erosion. After heavy precipitation water cannot be absorbed quickly enough, so it runs down to the valleys causing floods. Other results of the excessive forests cutting are trees diseases sometimes leading even to death of many trees.

Maintaining the optimal groundwater level is very important for agriculture. This is especially important in upland regions and may be controlled by retention of rainwater. The best

solution is collecting water in ponds formed on watercourses, which enables protecting riparian forest – the ecosystem of our temperate climate which is the richest in species.

Rich soil is vivid soil

In the arable layer on the area of 1 hectare there is usually about 20 tons of the mass of living organisms. In one gram of rich soil about 4000 various species of bacteria are present. As many as 40 000 to 3 million species of bacteria are thought to occur in the biosphere (Trevors 1998). Lately the number of species of bacteria in the biosphere has been estimated at more than billion (Dukhuizen 1998). We can hardly imagine the influence of this huge number of organisms on environment, their metabolism and physiology, as biologists have identified about 5000 species of bacteria and most of them are not well known. Nevertheless, multitude of bacteria is necessary to maintain the balance in the ecosystem. Even small amount of artificial fertilizers or chemicals may violate the balance: a process of soil regeneration may be broken and soil may become less fertile. To prevent this farmers apply mineral fertilizers and other chemicals, like pesticides or herbicides, which means another active intervention into natural ecosystem. Thus environmental pollution increases and the soil becomes useless for agricultural purpose. A botanical garden might be a right place to study the problem of maintaining a natural fertility of soil and its ability to regenerate.

Biofuels

The so called biodiesel, which is an esterified vegetable oil, may replace a fuel oil. It can be acquired from colza or sunflower. Another solution could be methanol production on the basis of crude oil, as a result of dry distillation of the biomass. With regard to colza, for industrial purpose it may be cultivated in the industrially polluted area and in the vicinity of roads. But, some questions arise: How would a mass production of colza influence the total food effect? Would it cause the soil erosion? In a botanical garden such problems could be studied.

Phenological pattern

Agricultural calendar dates are sometimes useless for applying the techniques of particular plants cultivation. However, the right date means better results. A good solution for a given region is establishing local dates on the basis of the observations plant growth cycles. A branch of science studying relationships between dates of cyclic phenomena in life of plants and animals and weather conditions is called phenology. Especially helpful are observations of life forms of plants like phanerophytes, chamephytes, hemicryptogams, geophytes or terraphytes (Tab. 1) during a break in the vegetation (in our climate it is winter time). Such observations could be gathered in chosen collections, for example, in International Phenological Gardens.

Other phenologically interesting forms are:

- Thermophytes – plants adapted to high temperatures intolerant of cold,
- Ephemerophytes – plants with durable underground parts (rootstocks, tubers), producing shortly living aboveground parts merely briefly,
- Ephemeres – plants of a very short life cycle.

In Europe current network counts 57 International Phenological Gardens and covers

Table 1. Life forms of plants

Life form	Description
Phanerophytes	plants with renewable buds above the level of the ground, i.e. all trees and bushes having wintering buds covered with husks, evergreen bushes
Chamephytes	plants with renewable buds close to the level of the ground, in the winter hidden under snow or with the litter
Hemicryptogams	plants with renewable organs partly hidden in the ground and partly with the litter
Neophytes	plants with organs wintering under the ground, mainly: perennial plants, rhizomous plants, tuberous plants, bulbous plants
Terraphytes	annual plants wintering exclusively in the form of seeds

different climate regions from the cold to the warm climate and from the maritime to the more continental areas. They play an important role in the process of a local agriculture and forest service development.

BOTANICAL GARDEN AS A GENE BANK

In many developed countries, also in Poland, numerous gene banks have been established in order to conserve crops and other major socioeconomically valuable plant species diversity. For this purpose special store-rooms are built up in which seeds and tissues are deposited. A contemporary botanical garden seems to be a right institution to elaborate and introduce methods of storing genetic resources. The most important aim is to find effective methods of conserving those species of plants, that have become endangered or rare. Nevertheless, gathering and estimating genetic resources is not the only task, first of all it is necessary to maintain plant species alive, also cultivated plant species. Old varieties of crops have priceless gene resources, that may appear indispensable in the future, because they are well adapted to local environmental conditions and resistant to diseases and pests, although not high-cropping. Introducing new more productive yet less resistant to changing environmental conditions species instead of old varieties may lead to a serious disturbance of natural balance of agricultural ecosystems through decrease of biodiversity. Gene banks have developed intensively lately, collecting gene resources of contemporary crops. Their long-term activity gives a unique chance to conserve the existing resources for next generations. Seeds, parts of plants and isolated tissues kept in steady conditions will be able to provide pure genes present in contemporary genotypes. Purity of the methods of storage together with every-year gene expression guarantee the active protection of gene resources. The ex situ gene banks, i.e. botanical gardens, are able to conserve genotypes in an active way and to introduce them to natural conditions (Puchalski et al. 2002).

There are more than twenty centres of plant genes resources protection in Poland, for example Botanical Garden – Centre for Biological Diversity Conservation of the Polish Academy of Sciences in Powsin near Warsaw or Botanical Garden of Plant Breeding and Acclimatization Institute in Bydgoszcz. Both institutions are the gene banks, in which precious old varieties of plants are cultivated in the fields (*in situ*). The work of plantators and farmers for hundreds of years has resulted in many precious plant varieties, that are today living resources of the genetic potential. These resources are indispensable for new varieties of cultivated plants selection. Those who understand it best are American scientists working on crops acquisition from European, Asian and African old genetic centres. Until lately old archaic forms and varieties have been believed not to be useful for cultivation. However, they appeared unusually valuable for this purpose as a basic source of genes containing information about some characteristic resistance to various conditions, for example, low temperatures, specific pathogens or chemical contamination. Thanks to genetic engineering, such genes could be isolated and transferred to other less resistant but more productive varieties, which might result in receiving genetically modified resistant and high-productive organisms.

Gene resources protection is nowadays a priority and as a crucial task it is mentioned in conservation acts and international conventions. In spite of the great effort of farmers, foresters and naturalists works on gene resources of crops protection are still insufficient. We really have to do our best to avoid the situation that in a couple of years we will be forced to use gene resources kept in banks of foreign countries in order to obtain local varieties of plants. Luckily, today there are many places in Poland, like Botanical Garden in Bolestraszyce near Przemyśl or the mentioned above Botanical Garden in Powsin, where old tree varieties are cultivated for conservation together with necessary renewal.

Necessity of conservation concerns also rye and its derivative triticale. It is rye that for years has decided of agricultural activity in these parts of Poland, where soil was rather poor. In this situation Polish farmers and botanists have elaborated a big number of varieties of this plant, which is about 600 taxons. With regard to triticale, it is worth mentioning that this species was an original idea of Polish scientists. Today several varieties of this plant are cultivated.

It is true that varieties show unstableness of some features, however, what is an essence of the achievement, i.e. a stable hybrid organism, demands conservation by every year renewal of the population. The problem is studied, among others, in Botanical Garden in Powsin. Old rye varieties are continuously renewed in experimental plots in Powsin and Bydgoszcz. Old varieties of potato are treated in a similar way. Bulbs are kept in a state of deep hibernation and from time to time genetic resources are renewed in vegetative cycle. Such activities are practiced mainly in the United States of America. Thus there is an urgent necessity to intensify works on gathering and preserving local varieties of potato and other valuable crops in botanical gardens of Poland.

Botanical gardens offer agriculture priceless services concerning maintaining not only collections of old cultivated varieties, but also special collections like industrial plants, plants for reclamation, energetic plants, spice plants, medicinal plants, grasses, papilionaceous plants or melliferous plants. Melliferous and pollen plants cultivation is a great advantage for agriculture, because not only it influences development of bee-keeping, but also causes increase of crops of plants effectively pollinated by bees and other insects.

These are the most important crops providing bees with benefit:
Fruit trees – apple, pear, cherry and plum trees,
Fruit bushes – gooseberry, currant, raspberry,
Agricultural cultivation – colza, buckwheat, mustard.

Nevertheless, there are other melliferous and pollen species. In Poland several dozen field species of crops are usually pollinated by bees; about 140 species of horticultural plants, among them many species of vegetables and medicinal plants as well as 15 species of fruit trees and bushes. If we take into account decorative plants, there will be even twice as much. A botanical garden may play a role of a promoter of such plants species application in agricultural areas.

Gathering gene resources is useful for reclamation of devastated areas, enriches a valuable research material and enables more effective search of genotypes of plants adapted to vegetation in extremely contaminated environment. Contemporary botanical gardens fulfil a significant role in maintenance of the biological diversity of plants in the same manner as zoos of animals. In the light of contemporary needs a regional botanical garden should function as:

1. Main centre of the ecological network.
2. Regional centre of biodiversity conservation.
3. Source of genes for genetic engineering and biotechnology.
4. Storage – bank of gene resources (the ark of Noah of the 21st century).
5. Gene bank of valuable plant raw materials.
6. Plant association area as a guarantee of the persistence of species in the environment.

1. Main centre of the ecological network

The expansion of the industrial civilization of the end of the 20th century into the environment today, at the beginning of the third millennium, has exceeded the capacity of local ecosystems. Development of the communication network in the world (roads, railway etc) caused separation of local populations of plants and animals in specific genetic ghettoes and the expansion of invasive foreign species; for example, in Poland: *Impatiens glandulifera, Reynoutia japonica, Solidago gigantea* and others.

In spatial management plans there is usually emphasized a necessity of the local landscape protection. Especially in urban terrains the environment friendly network is necessary for protecting the condition of natural resources by creating corridors for animals and plants migration.

Significant elements of the environment friendly network are the so called natural monitoring stations, i.e. centres of the protective activity, which are parks of the biosphere, natural reserves as well as modern botanical gardens. Also numerous small botanical gardens, including private gardens, schools gardens, biotope squares in towns and villages may complete the system of biological connections in the area of human activity. In Europe good examples may be over 100 newly created gardens in Paris, numerous new squares and environment friendly gardens round London, as well as several dozen parks with interesting botanical collections in Rome. Another magnificent example is the capital of Taiwan – Taipei, that have recently changed into a green city because its inhabitants created hundreds of gardens, parks and squares. In Poland a new pro-

gram "Ecological Systems of Protected Areas" is an attempt to create such network in towns of Upper Silesia.

2. Regional center of biodiversity conservation

According to Biological Diversity Convention accepted in 1992 in Rio de Janeiro, known as Agenda 21, as well as to the principle of the sustainable development accepted by European states, every country is obliged to self-protection, i.e. protection of local gene resources, manifesting itself in diversity of organisms. Any country may realize tasks concerning protection of gene resources in the following manners:

A conservatively – through creating various forms of legal protection of natural resources, like national parks, reserves of the biosphere and local nature reserves,

B actively – through endangered species of animals and plants protection in zoological and botanical gardens,

C passively – in gene banks.

Because there are no safe methods of reserve protection, it is necessary to create complete collections of species assemblages in protected areas, like botanical gardens, corresponding to assemblages in local natural reserves (Puchalski 1999, 2000).

3. Source of genes for genetic engineering and biotechnology

We are living in the beginning of the third millennium of human civilisation, in the fourth age of the technological revolution and, unfortunately, within an age of dying out of species on the Earth. This phenomenon is over thousand times as great as dying out of dinosaurs in the Mesozoic era. At the same time contemporary world is full "of fruits of human work". Some of them are either attractive or alarming like the last achievements in genetics and biotechnology. Human economics has gained control of life on the Earth. Some aspects of this process are really worrying, for example production of modified genetically food, perceived a salvation from hunger.

A necessity of preserving the widest possible biodiversity of wild species of agricultural plants is obvious. A numerous newly founded gene banks may become a solution (Gromadzenie...2001). Good examples are: the banks in Pillnitz and Gatersleben, Germany or the bank in Geneva, New York, USA.

4. Storage – bank of gene resources (the ark of Noah of the 21st century)

Contemporary botanical gardens with their gene banks play a significant role in maintaining the biological diversity of plants on the Earth. However, gene banks are often undervalued. There is a lack of means for maintenance of the collection of gene resources and their application in spite of the fact that these are the richest banks in the world, of which capital is priceless (Table 2).

We may observe a noticeable development of gene banks in the world with admiration. For example, in the Royal Botanic Gardens, Kew, Great Britain, the Millennium Seed Bank Project has been realized in Wakehurst Place (Sussex Shire), called the Noah's ark of the 21st

Table. 2. Some advantages of introduction specific genes to crops

No.	Plant	Origin of genes	Application	Institution	Profits
1.	Barley	Plant coming from Ethiopia	Protection against the virus disease	American Department of Agriculture	160 million dollars
2.	Wheat	Wild variety from Turkey	Resistance to pathogens	American Department of Agriculture	50 million dollars per year
3.	Hop	Wild hop Wild hop	"better bitterness" of English beer	British breweries	15 million dollars in 1981 only
4.	Rice	Wild variety from the river valley in India	Protection against the virus disease	International Institute of Rice Research, Philippines	Rescue from starvation for hundreds of millions people

century. It will become storage for thousands of species of endangered and rare plants including the whole flora of British islands and the endangered desert flora. In Poland a cryogenic bank of seeds of rare and dying out plants called Centre for Biological Diversity Conservation has been organized in Botanical Garden of the Polish Academy of Sciences in Powsin near Warsaw.

There is a danger of a sudden reduction of the biological variety and of loss of heritage of the living world, followed by intruding genetically modified vital organisms and invasive plants. So may be it would be better to keep gene resources of naturally selected plant populations until the time we are able to solve the problem. What we need to do now is to promote the idea of biodiversity conservation.

5. Gene bank of valuable plant raw materials

Collections of plants, that are useful for civilization, have already been conserved by agricultural, forest or medical institutes. For example, in Poland the world collection of species and varieties of rye, *Secale* spp is deposited. Melliferous plants are protected by associations of bee-keepers. Herbs and medicinal plants are stored in numerous collections.

Valuable species of decorative plants are reproduced and their gene resources are restored every year. The same concerns cultivated forest plants – some trees, especially the pine tree, are still reproduced in nurseries. With regard to perennials and ground flora, mainly valuable species are protected. There is an urgent necessity of collecting local wild weeds, that are strongly endangered by more and more perfect cultivation methods and by more and more aggressive colonizing the traditional agrocenoses by invasive species. We should carry about decreasing gene resources of many plants like: *Agrostema gitago, Hyosciamus niger, Adonis aestivalis* and others, that were once just weeds. Now they are able to survive in botanical gardens, where they may be reproduced and then reintroduced into the environment.

6. Plant association area as a guarantee of the persistence of species in the environment

We have to realize very clearly that conservation of all gene resources as the natural heritage is absolutely necessary. Such conservation can be accomplished by building up gene banks and botanical and zoological gardens where the resources could be collected and conserved. Gene banks are not only the archives of the valuable genes, but also the places of conservation of the biodiversity for maintaining the biological balance. The best way to conserve rare and becoming extinct species out of gene banks is their periodic reproduction in natural environmental conditions that may be created in botanical gardens.

CONSERVATION OF BIODIVERSITY

If we ask a question: "Which of the tasks of contemporary botanical gardens is the most important?", the answer will be obvious: conservation of biodiversity (Czembor et al. 1994; Dyduch-Falaniowska and Liro 2000; Galera et al. 1999; Galera et al. 2000; Galera et al. 2001; Podyma 2000; Puchalski 2000; Ryszkowski, Bałazy 1991; Zarzycki, Lankosz-Mróz 2000). But, what is the aim of conservation of biodiversity? How should we understand the mission of contemporary botanical gardens?

Generally conservation of biodiversity is expected to help to maintain the dynamic balance in the nature. As it is the nature, that enables human existence on the Earth. For our sake we should protect our natural environment – a system that is able to self-regulate. However, the self-regulation is possible only if the system is complex enough to be able to balance the effects of human activity and of geophysical processes. It is just life in its diversity that creates conditions for life here and now. "Here and now" means responsibility for all living forms that co-exist with us in the same space and in the same time. Our responsibility in this matter should be proportional to the area inhabited and changed by the mankind.

Conservation of biodiversity here and now has become a reason of state rather than a fad, a necessity rather than a choice. Thus the question about the best ways to conserve the world biodiversity is the question about comprehensive rather than short-term solutions.

In the regulation concerning the nature protection two kinds of conservation are specified: *in situ* and *ex situ*. The in situ conservation is connected with conservation and occurs mainly

in the areas protected by law. The *ex situ* conservation is of active character, its goal is to predict negative changes and to prevent them. For this purpose plants and seeds from various populations of natural endangered species, subspecies and varieties are collected, so that may be used to reintroduction to their original habitats or to new environments (Zarzycki and Lankosz-Mróz 2000).

Yet, are botanical gardens and gene banks ready to realize their mission? What conditions have to be fulfilled to create a plant collection of plants and seeds from various populations? It is worth emphasizing that a collection of specimen from various populations is under consideration, not a collection of individuals. The last may be at most used for education or decoration, but cannot be regarded the *ex situ* collection. The problem needs some comments.

Let us begin with the basic condition – a habitat (Dobrowolski, Lewandowski 1998). The habitats for collections should be as similar to natural conditions as possible to protect successive plant generations from the excessive selection caused by changes in the environment and from genetic erosion connected with too small population. So the chosen population should rather be a part of a plant association than a separated group and its size should be similar to the smallest natural populations. If the species occurs in many regions of the country, the population should come from the region, where the *ex situ* cultivation takes place (the local population), not from various regions, to avoid the exchange of the genetic material of populations. Thus in the botanical gardens applying the *ex situ* protection the conditions for the whole natural plant associations should be ensured, so that they would be able to self-renovate. But, the conditions should be under control to avoid the unintentional succession.

The presented above solution concerns "the genetic heritage", that needs to be conserved in the special collections of native wild plants, like protected, endangered or rare plants. It should be realized through national programs of biodiversity conservation of the highest priority.

Another problem, which is worth considering, is the example of a wild species population and its cultivated varieties. One of the basic tasks of botanical gardens is to coordinate both national and international seed exchange. This enables enriching regional gene resources and introducing new species of plants in agriculture and forestry. For instance, the apple tree collection should include wild species, historical (regional) varieties, cultivated and industrial varieties. All varieties are genetic clones, that in the collection do not need to be represented by a big number of individuals, while the wild species collection must be numerous as it forms a genetic deposit. In the case of the apple tree it is not necessary to create the complete associations to ensure the right development of the populations, however, as apple trees are present in all regions of Poland, cultivating the wild populations and multiplying the cultivated varieties in different regions would be a good solution. All taxons play an important role in the national economy, the same concerns other plants, like vegetables, cereals, fruit and industrial plants, thus their protection should be taken into account in the national programs of biodiversity conservation (Krajowa strategia...2000).

The last problem, that we would like to discus here concerns the introduced taxons, that are present in Poland either in agricultural cultivations or in botanical collections. In our opinion this is the most controversial group of taxons with regard to including them in the national programs of biodiversity conservation. However, before we make a decision about them, we ought to determine the purpose for such collection. There are several categories that enable estimating the importance of the taxons in the programs of biodiversity conservation:

1. Introduced crops – present in our fields for centuries; products made of them are often present in our menu. Most of these plants show a significant genetic variability, reproduce vegetatively and usually are members of local populations only. Some of them have adjusted to the local conditions, thus becoming an element of our natural heritage, so it is worth protecting them. With regard to plants that reproduce generatively, their collections should be created where it is necessary to maintain them.

2. Introduced plants protected by international programs – it is worth mentioning that since 1981 Poland has been taking part in the European Cooperative Programme for Crop Genetic Resources Networks ECP/GR, in which we cooperate with foreign gene banks.

Fig. 1. View of the Fiołkowa Hill from the Mokre village.

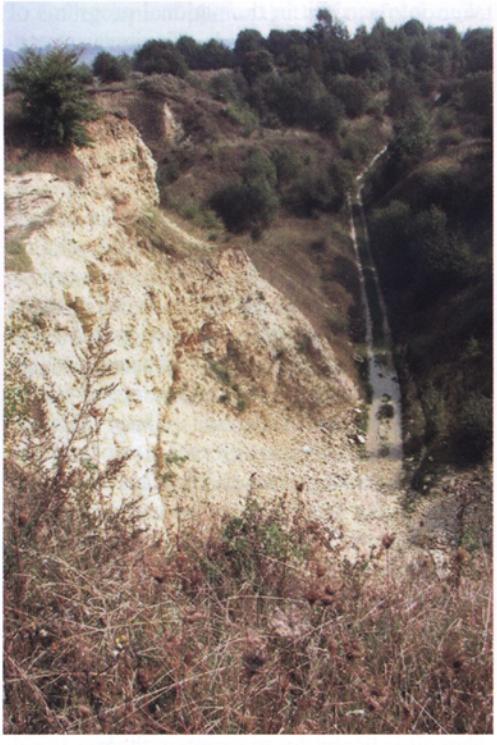

Fig. 2. Part of mine workings of the Triassic limestone.

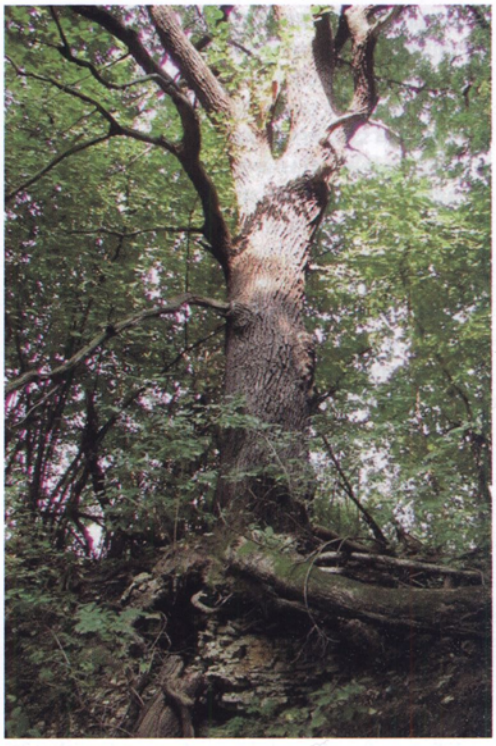

Fig. 3. Oak on the limy rock on the border of mine workings.

Fig. 4. Old stove to burning the limestone.

Fig. 5. The view of mine workings of the limestone and surrounding fields.

Fig. 6. Fishpond on the Jasienica stream.

Fig. 7. Bigger fishpond on the Jasienica stream.

Fig. 8. The Jasienica stream.

Poland is responsible for international collections and databases of *Secale, Pisum* and *Festuca*. Our country is a member of Treaty on Plant Genetic Resourses of the FAO and is taking part in Global Plan of Action on Plant Genetic Resources for Food and Agriculture. This obliges us to protection the species listed in the international programs of biodiversity conservation.

3. Introduced decorative plants – that complete the gene resources of national species, subspecies and varieties (the same family or genus).

4. Commercial collections of taxons of decorative plants – playing the role of resources and self-financing.

5. Non-commercial collections of foreign species should not be taken into account in the national programs, unless they are mentioned in the international programs.

6. Specialized collections of introduced plant of educational value, which are not important to the protection of biodiversity in our country should not be financed by means of the national programs of *ex situ* biodiversity conservation.

THE VISION OF THE GARDEN IN MIKOŁÓW-MOKRE

From a point of view of a naturalist the southern edge of the Upper Silesian Industrial Area is one of the most interesting areas of the region with unusually diversified landscape. Seems impossible? Yet, since 1997 in that place, in the Mikołów the Silesian Botanical Garden has been created.

It is going to be the first botanical garden of such character in the Upper Silesia. It is worth mentioning, that although in the area of Czech Republic, there is a dendrological-botanical garden in the Silesia near Opava, founded in 1966. In Silesian Province the idea of a botanical garden is not new. In 1972 efforts were made to create one in Wojewódzki Parku Kultury i Wypoczynku in Chorzów. The project was supported by the province governor general Jerzy Ziętek, whose activity for Upper Silesia development was priceless. Unfortunately, the project failed. Another attempt was made eight years later when a garden was planned in Leśny Park in Katowice, it was fruitless, too.

All activities and works for the new Garden in Mikołów foundation have been coordinated by the Association for Upper-Silesian Botanical Garden, founded on 21st April 1997. Since the beginning the Association has been provided a great support from either local authorities in Mikołów or regional in Katowice. The Garden has become an official element of the development strategy of the Silesian Province (Szendera and Kojs 1998; Włoch et al. 2000). On 18th October 2004 the Garden became a member of the Council of Botanical Gardens in Poland, and lately an attempt has bee made by the founders to enter the Botanical Garden Conservation International.

In 2003 the Union of Associations "Silesian Botanical Garden" was founded, whose activity concerns the Garden in Mikołów and Arboretum of Moravian Gate in Racibórz (Duda 2001ab; Duda et al. 2001ab). The members are: the Association for Upper-Silesian Botanical Garden, Polish Academy of Sciences, University of Silesia, Silesian voyevodship, Mikołów district, Polish Ecological Club and some other organizations.

The area of the Garden was chosen purposefully because of both its diversity and landscape. The last is especially attractive for the charming places, like Fiołkowa Hill, Sośnia Hill, lime workings and valleys of the streams. That is why it has always been visited by inhabitants and tourists. The highest point is Fiołkowa Hill, 340.4 m. In the ground flora of its forests many *Viola* species can be found, among them the *Viola odorata* is the most numerous. Before the World War II a lime rock used to be exploited there. Still there are some idle workings on the hill. Especially interesting is the fact, that the rock was acquired by means of the unique drift method (Duda et al. 1998; Wika and Włoch 1998).

There are many interesting objects there in the area of the Garden, like lime stone-pits, in which successive geological epochs can be recognized. Nearby a number of old lime stoves are situated. First of them were built probably in 1749. Since that time the stoves have been present as specific elements of the local landscape, a testimony of the material culture of this land. According to the plans they are going to be applied to the presentation of climbing plants collection in the Garden. It is worth mentioning that there is no other place in Poland where so many lime stoves in such a good condition could be found. In the group of the oldest stoves and lime galleries on Fiołkowa Hill the day habitats for at least seven species of bats occur.

Various kinds of terrains occur in that area. For example, water-logged meadows, of which the most beautiful one is situated along the northern bank of Jasienica stream. The wet area will probably be used for a big marsh plants collection and numerous ponds – for an aquatic plants collection. Other types of terrains are: xerothermic grasses, water-logged forests, riparian forests, lime soils. This diversity will be very helpful in providing proper conditions for various plant collections and will enable to lower expenses.

Forty nine various associations of plants occur in the Garden, nine of them are extremely rare, like the association with a calciphilous plant *Gentianella ciliata* or with *Chrysosplenium alternifolium*. A relatively big group are plants under strict protection, among them are: *Daphne mezereum, Doronicum austriacum, Veratrum lobelianum, Vinca minor* and several species of orchids, like *Orchis mas-*

cula and *Orchis pallens*, both are rare taxons (Berger 2001; Ogrodnik 2001ab; Ostoja and Berger 2000; Szendera 1998).

There are over 650 taxons of vascular plants naturally growing in this area; except for higrophilous and mezophilous plants of deciduous forests, also plants of various kinds of meadows and fields as well as mountain species and protected plants occur there. Among various plant associations especially interesting are free-growing bushes, dry-ground forests and xerothermic grasses occurring mainly on Sośnia Hill and beech forests with beautiful lily of the valley in the ground flora. The biggest variety of plant associations occur in the valleys of Promna and Jasienica streams. Some valuable associations can be found in the forest complex – the arboretum to-be, in the stonepits, where a rock garden is planned and along one of the Promna stream inflows – a perfect localization for decorate plants collections. It is also worth mentioning that with regard to the number of monumental trees the area is unique. What is more, there are numerous animals tracks and wildlife refuges there.

This unusual biodiversity of the area neighbouring with urban terrains is a great chance for the local natural environment regeneration. In Mikołów-Mokre many peculiarities of inanimate nature have been conserved: deep ravines, stream valleys, lime outcrops, all of them making the landscape interesting. To protect the biodiversity it is necessary to conserve the rare plant associations, which are on the so called Red List of the endangered plants of Upper Silesia. There are six association of this kind in the area. All the existing in the Garden plant association will be protected, revitalized and renaturalized.

The area of 131 hectares is going to be fenced, of which almost 80 hectares belonging to the Silesian Province Treasury. In the project of the Province authority the whole area designed for the Garden with the buffer zone is of 534 hectares. In fact this is the optimal area for the institution of this kind in our region (Tresenberg 1998; Wika et al. 1997; Włoch and Szymanowska-Pułka 1998).

Silesian Botanical Garden to-be is corresponding to needs of the 21st century: modern, localized out of the center of town in the area big enough to cultivate extended collections, perfectly fitting to the local landscape, exceptional. However, its exceptionality does not concern its size (there are many big gardens in the world), but its favourable location and charming landscape. Because of the mentioned above diversity of habitats it will be possible to create collections of different kinds in the neighbourhood of one another in natural conditions.

All the mentioned features of the area make it ideal for the Botanical Garden. Thus in Upper Silesia we have the area of the unusual biodiversity, rich soils and beautiful landscapes. Isn't it worth conservation and protection? We should be proud of this unique area and show it to Poland and to the world.

The Garden will be a place of scientific activity, it will be a gene bank. Studies will probably concern some creative ways of plant reproduction or plant adaptation to urban conditions. It will also function as an educational centre, which will be a great advantage for inhabitants of the region (Drobnik 1998; Kojs 1998; Kojs and Szendera 1998; Kojs et al. 1998ab, 1999, 2000; Samojedny 1998; Włoch 1998; Włoch (red) 1999; Włoch et al. 1998). Silesian Botanical Garden seems also predestined to coordinate monitoring a biological diversity in the region. The aim of this kind of studies is to gather, to process and to make available quantitative and qualitative information of the current state the biodiversity (of genotypes, species, ecosystems) in different environmental conditions in all the country. On the basis of the obtained data it is possible to assess the direction and pace of the changes in the environment as well as their anticipation (Łukasiewicz and Puchalski 2002; Ochrona Różnorodności Biologicznej Polski – Krajowa Strategia i Plan Działań 1997; Puchalski 1998; Szendera 1999; Rusin et al. 2001).

Both the plant succession in lime workings and colonizing anthripomorphic habitats by native plants will be studied in the Garden. Soon in the natural habitats collections for gene resources of valuable plants of ground flora will be founded: of dry-ground and riparian forests of the southern Poland, of various types of beech forests and of lime rocks. A continuous monitoring of invasive plants will enable working out effective methods of limitations of these plants range, which will allow protecting and

enlarging the populations of the native field and river plants. Similar studies will concern rare and endangered species protection.

The newly organized Silesian Botanical Garden seems to be a great chance for development of agriculture and forest service in the Upper Silesia. The organizers of the Garden tend to connect their works and researches with the practical activity in the regarded fields. It is worth mentioning that a good co-operation with the local authorities made it possible to discuss and establish preliminary rules of such activity (Brząkalik et al. 2002).

An effort was made to join the Silesian Botanical Garden into the process of building up a new structure of the local agriculture and supporting it in order to elaborate and maintain a modern and competitive production. The cooperation of the Silesian University team with Polish Academy of Science and the local authorities resulted in working out a preliminary project, concerning works and actions for development of the Silesian agriculture, that may be organized in cooperation with the Silesian Botanical Garden. The project concerns the module program of function of a botanical garden in the Upper Silesia. This means that individual tasks are mostly independent projects and will be realized as long as it is necessary and as there are means to realize them. Among the presented by the Silesian Botanical Garden propositions the most interesting are the following:

1. regional centre of agricultural plant resource conservation:
   - for breeding and cultivation,
   - for scientific studies, like:
     - experimental field for free-growing trees and shrubs planting,
     - field for breeding and reproduction of the plant species for devastated terrains reclamation,
     - collections and field for cultivation of rare and becoming extinct species of weeds and crops,
     - collection of herbs and medicinal plants,
     - collection of spices and seasonal vegetables,
     - collection of melliferous plants,
     - collection of industrial plants,
2. experimental area for rain-water retention studies,
3. regional centre of studies on soil fertility in ecological farms and on possible ways of contaminated soil purification,
4. regional centre of seed production, tree nursery, gardening and fruit-farming,
5. regional centre of phenologic researches for agrotechnics and experimental area for optimal crop rotation observations,
6. centre of agrobiological education on the basis of experiments in bioagronomy,
7. centre of new technologies in agriculture with:
   - experimental field for energetic plants application,
   - centre of implementation in technology of renewable energy,
8. regional deposit of being licensed species and varieties.

A list of possible tasks to realize in the centres of natural sciences of the Garden is much longer. However, it is worth discussing those of the tasks that, in our opinion, play the most important role in the process of social transformation of the Polish agriculture.

SUMMARY

The Red List of endangered plant and animal species has been enlarging alarmingly. Predictions are serious: within next twenty years about 20% of the world species will extinct. In our industrial region almost 40% of vascular plant species is about to die out. For the past two hundred years 124 species of these plants have died out completely or vanished of the area of Poland. These are dramatic changes in agricultural methods that are responsible for this genetic erosion. First of all we are obliged to conserve biodiversity, not only in the natural environment, but also in agrocenoses. Another important task is to conserve gene recourses of the crops in order to provide a material for new varieties cultivation.

One of the methods of gene recourses conservation in a botanical gardens is the *ex situ* method meaning conservation of the genetic material of plants out of their natural habitats. The *ex situ* conservation may be localized in:

- seed storage,
- *in vitro* tissues storage,
- pollen storage,
- field collections.

In all fields of our activity we have to take into account the sake of the environment – this is the condition *sine qua non* condition for our existence. Of course, the problem concerns agricultural activity as well. The procedures applied in contemporary agriculture are leading to augmentation the efficiency of production, often to the over-production of unwanted poor food. Luckily, there are farmers, foresters and naturalists, who understand the natural phenomena and are aware of possible limits of human intervention into the environment. Agriculture needs to be supported by naturalists and botanists in creating a model of aware, environment friendly farmer – a potential guarantee of its stability. This task may be realized in contemporary botanical gardens.

Silesian Botanical Garden in Mikołów-Mokre will serve as scientific, educational and cultural centre; will stimulate the sustainable development as well as renovating and maintaining the natural balance in the region. It will conserve a diversity of plant species – a basis of natural food production, thus cooperating with the local agriculture. The Garden is expected to change the image of Upper Silesia (Berger et al. 2000).

Modern botanical gardens are necessary to maintain the balance in our civilization development.

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